What is claimed is:

1. A method of producing a porous flow field material for a bipolar separator plate, the method comprising:

positioning at least two layers of woven wire mesh in a stacked arrangement; and

bonding together the at least two layers of woven wire mesh to form the porous flow field material, wherein the bonding together is achieved by diffusion bonding, continuous resistance welding, continuous sintering, or a combination thereof.

2. The method of claim 1, further comprising:

prior to the bonding together, positioning an additional layer of woven wire mesh on top of the at least two layers of woven wire mesh positioned in a stacked arrangement, such that the at least two layers of woven wire mesh and the additional layer of woven wire mesh are bonded together to form the porous flow field material;

wherein the additional layer of woven wire mesh has warp and weft mesh counts which are higher than the warp and weft mesh counts of the at least two layers of woven wire mesh.

3. The method of claim 1, wherein the at least two layers of woven wire mesh comprise a first layer of a first woven wire mesh and a second layer of a second woven wire mesh.

4. The method of claim 1, further comprising:

cleansing, degreasing, annealing, tensioning, stretching, calendering, compressing or plating the at least two layers of woven wire mesh prior to bonding together.

5. The method of claim 1, wherein the bonding together is achieved by diffusion bonding.

6. The method of claim 1, wherein the at least two layers of woven wire mesh comprise three layers of a plain square weave wire mesh having warp and weft mesh counts of 42 wires per inch, with wires having a nominal diameter of 0.0055″ prior to weaving and arranged in a repeatable sequence of angular orientations of (0°, 45°, 0°).

7. The method of claim 2, wherein the at least two layers of woven wire mesh comprise three layers of a plain square weave wire mesh having warp and weft mesh counts of 42 wires per inch, with wires having a nominal diameter of 0.0055″ prior to weaving and arranged in a repeatable sequence of angular orientations of (0°, 45°, 0°); and wherein the additional layer of woven wire mesh comprises a layer of a plain square weave wire mesh having warp and weft mesh counts of 150 wires per inch, with wires having a nominal diameter of 0.0026″ prior to weaving.

8. A method of producing a porous flow field material for a bipolar separator plate, the method comprising:

bonding a single layer of woven wire mesh including warp wires and weft wires to form the porous flow field material, wherein the bonding comprises bonding together the warp wires and the weft wires at at least substantially all of their points of contact within the woven wire mesh, and wherein the bonding is achieved by diffusion bonding, continuous resistance welding, continuous sintering, or a combination thereof.

9. The method of claim 8, further comprising:

cleansing, degreasing, annealing, tensioning, stretching, calendering, compressing or plating the single layer of woven wire mesh prior to bonding.

10. The method of claim 8, wherein the bonding is achieved by diffusion bonding.

11. A porous flow field material for a bipolar separator plate, comprising:

at least two layers of woven wire mesh bonded together by a metallurgical bond, wherein the metallurgical bond is formed by diffusion bonding, continuous resistance welding, continuous sintering, or a combination thereof.

12. The porous flow field material of claim 11, further

comprising:

an additional layer of woven wire mesh, such that the at least two layers of woven wire mesh and the additional layer of woven wire mesh are bonded together by the metallurgical bond;

wherein the additional layer of woven wire mesh has warp and weft mesh counts which are higher than the warp and weft mesh counts of the at least two layers of woven wire mesh.

13. The porous flow field material of claim 11, wherein the at least two layers of woven wire mesh comprise a first layer of a first woven wire mesh and a second layer of a second woven wire mesh.

14. The porous flow field material of claim 11, wherein the metallurgical bond is formed by diffusion bonding.

15. The porous flow field material of claim 11, wherein the at least two layers of woven wire mesh comprise three layers of a plain square weave wire mesh having warp and weft mesh counts of 42 wires per inch, with wires having a nominal diameter of 0.0055″ prior to weaving and arranged in a repeatable sequence of angular orientations of (0°, 45°, 0°).

16. The porous flow field material of claim 12, wherein the at least two layers of woven wire mesh comprise three

layers of a plain square weave wire mesh having warp and weft mesh counts of 42 wires per inch, with wires having a nominal diameter of 0.0055″ prior to weaving and arranged in a repeatable sequence of angular orientations of (0°, 45°, 0°); and wherein the additional layer of woven wire mesh comprises a layer of a plain square weave wire mesh having warp and weft mesh counts of 150 wires per inch, with wires having a nominal diameter of 0.0026″ prior to weaving.

17. The porous flow field material of claim 15, wherein the plain square weave wire mesh comprises an austenitic stainless steel alloy.

18. The porous flow field material of claim 16, wherein the plain square weave wire mesh having warp and weft mesh counts of 42 wires per inch comprises an austenitic stainless steel alloy, and wherein the plain square weave wire mesh having warp and weft mesh counts of 150 wires per inch comprises an austenitic stainless steel alloy.

19. A porous flow field material for a bipolar separator plate, comprising:

a single layer of woven wire mesh including warp wires and weft wires, wherein the warp wires and the weft wires are bonded together by a metallurgical bond at at least substantially all of their points of contact within the woven wire mesh, wherein the metallurgical bond is

formed by diffusion bonding, continuous resistance welding, continuous sintering, or a combination thereof.

20. The porous flow field material of claim 19, wherein the metallurgical bond is formed by diffusion bonding.

21. The porous flow field material of claim 19, wherein the warp wires and the weft wires comprise an austenitic stainless steel alloy.

22. A method of producing a bipolar separator plate, the method comprising:

positioning at least one gas barrier layer adjacent to at least one porous flow field material, wherein the at least one porous flow field material comprises:

at least two layers of woven wire mesh bonded together by a metallurgical bond, wherein the metallurgical bond is formed by diffusion bonding, continuous resistance welding, continuous sintering, or a combination thereof; and

bonding together the at least one gas barrier layer and the at least one porous flow field material, wherein the bonding together is achieved by diffusion bonding, continuous resistance welding, continuous sintering, or a combination thereof.

23. The method of claim 22, wherein the at least one porous

flow field material further comprises:

an additional layer of woven wire mesh having warp and weft mesh counts which are higher than the warp and weft mesh counts of the at least two layers of woven wire mesh, wherein the at least two layers of woven wire mesh and the additional layer of woven wire mesh are bonded together by the metallurgical bond.

24. The method of claim 23, wherein the at least one gas barrier layer comprises a solid metal foil.

25. The method of claim 24, wherein the solid metal foil includes etched or otherwise formed flow channels.

26. The method of claim 23, wherein the at least two layers of woven wire mesh comprise a first layer of a first woven wire mesh and a second layer of a second woven wire mesh.

27. The method of claim 23, wherein the metallurgical bond is formed by diffusion bonding, and the bonding together is achieved by diffusion bonding.

28. The method of claim 23, wherein the at least two layers of woven wire mesh comprise three layers of a plain square weave wire mesh having warp and weft mesh counts of 42 wires per inch, with wires having a nominal diameter of 0.0055″ prior to weaving and arranged in a

repeatable sequence of angular orientations of (0°, 45°, 0°); and wherein the additional layer of woven wire mesh comprises a layer of a plain square weave wire mesh having warp and weft mesh counts of 150 wires per inch, with wires having a nominal diameter of 0.0026" prior to weaving.

29. A method of producing a bipolar separator plate, the method comprising:

positioning at least one gas barrier layer adjacent to at least one porous flow field material, wherein the at least one porous flow field material comprises:

a single layer of woven wire mesh including warp wires and weft wires, wherein the warp wires and the weft wires are bonded together by a metallurgical bond at at least substantially all of their points of contact within the woven wire mesh, wherein the metallurgical bond is formed by diffusion bonding, continuous resistance welding, continuous sintering, or a combination thereof; and

bonding together the at least one gas barrier layer and the at least one porous flow field material, wherein the bonding together is achieved by diffusion bonding, continuous resistance welding, continuous sintering, or a combination thereof.

30. The method of claim 29, wherein the at least one gas barrier layer comprises a solid metal foil.

31. The method of claim 30, wherein the solid metal foil includes etched or otherwise formed flow channels.

32. The method of claim 29, wherein the metallurgical bond is formed by diffusion bonding, and the bonding together is achieved by diffusion bonding.

33. A bipolar separator plate comprising:

at least one porous flow field material comprising at least two layers of woven wire mesh bonded together by a first metallurgical bond, wherein the first metallurgical bond is formed by diffusion bonding, continuous resistance welding, continuous sintering, or a combination thereof; and

at least one gas barrier layer bonded to the at least one porous flow field material by a second metallurgical bond, wherein the second metallurgical bond is formed by diffusion bonding, continuous resistance welding, continuous sintering, or a combination thereof.

34. The bipolar separator plate of claim 33, wherein the at least one porous flow field material further comprises:

an additional layer of woven wire mesh having warp and weft mesh counts which are higher than the warp and weft mesh counts of the at least two layers of woven wire mesh, wherein the at least two layers of woven wire mesh and the additional layer of woven wire mesh are bonded together by the first metallurgical bond.

35. The bipolar separator plate of claim 34, wherein the at least one gas barrier layer comprises a solid metal foil.

36. The bipolar separator plate of claim 35, wherein the solid metal foil includes etched or otherwise formed flow channels.

37. The bipolar separator plate of claim 34, wherein the at least two layers of woven wire mesh comprise a first layer of a first woven wire mesh and a second layer of a second woven wire mesh.

38. The bipolar separator plate of claim 34, wherein the first and second metallurgical bonds are formed by diffusion bonding.

39. The bipolar separator plate of claim 34, wherein the at least two layers of woven wire mesh comprise three layers of a plain square weave wire mesh having warp and weft mesh counts of 42 wires per inch, with wires having a nominal diameter of 0.0055″ prior to weaving and arranged in a repeatable sequence of angular orientations of (0°, 45°, 0°); and wherein the additional layer of woven wire mesh comprises a layer of a plain square weave wire mesh having warp and weft mesh counts of 150 wires per inch, with wires having a nominal diameter of 0.0026″ prior to weaving.

40. The bipolar separator plate of claim 38, wherein the plain square weave wire mesh having warp and weft mesh counts of 42 wires per inch comprises an austenitic stainless steel alloy, and wherein the plain square weave wire mesh having warp and weft mesh counts of 150 wires per inch comprises an austenitic stainless steel alloy.

41. A bipolar separator plate comprising:

at least one porous flow field material comprising a single layer of woven wire mesh including warp wires and weft wires, wherein the warp wires and the weft wires are bonded together by a first metallurgical bond at at least substantially all of their points of contact within the woven wire mesh, wherein the first metallurgical bond is formed by diffusion bonding, continuous resistance welding, continuous sintering, or a combination thereof; and

at least one gas barrier layer bonded to the at least one porous flow field material by a second metallurgical bond, wherein the second metallurgical bond is formed by diffusion bonding, continuous resistance welding, continuous sintering, or a combination thereof.

42. The bipolar separator plate of claim 41, wherein the at least one gas barrier layer comprises a solid metal foil.

43. The bipolar separator plate of claim 42, wherein the solid metal foil includes etched or otherwise formed flow

channels.

44. The bipolar separator plate of claim 41, wherein the first and second metallurgical bonds are formed by diffusion bonding.